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Research Article

Craniomaxillofacial War Injuries in Misrata, Libya

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ABSTRACT

Injury to the craniomaxillofacial (CMF) area has major implications for mortality and morbidity depending on many factors that influence the level of treatment. In warzones, the extent of CMF injuries is amplified mainly due to the damage caused by bomb blasts. This study presents CMF injury as the result of war incidents to highlight the differences in injury type as well as the impact that an austere environment has on treatment. The author has unique insight and experience of treating CMF injuries in Misrata, Libya, where there is ongoing civil conflict. Surgeons in Libyan hospitals require intensive training intervention to effectively manage gunshot injuries, blast injuries and disasters and while these cases represent an austere environment, conclusions can be drawn for recent incidents involving terrorism. This study presents an analysis of injury patterns of patients presenting with CMF trauma during the Misrata battle of the Libyan conflict in 2011.

Introduction

The civil war in Libya has dramatically affected the lives of the general population [1]. As Libya's third largest city, Misrata was severely affected by the conflict with war-related CMF trauma occurring throughout the siege and the multiple campaigns launched by pro-government forces to retake the city. Healthcare services were overwhelmed by the surge in traumatic injuries [2, 3]. At the time of the battle of Misrata itself, gunshot and blast injuries represented the majority of injuries [4]. Due to the occupation of the main city hospital in Misrata by pro-Gaddafi forces and the targeting of polyclinics, civilian and combatant casualties presenting with complex CMF injuries were treated in facilities which were not equipped to handle such cases [4]. Gunshot and blast injuries in war environments commonly affect the head and neck area and are often life-threatening [5]. Management of these injuries is challenging due to the anatomical complexity, and the functional and aesthetic consequences of poor reconstruction. It is therefore important that healthcare providers managing these injuries in austere and war environments, have the necessary knowledge and skills to achieve the best possible clinical outcomes with the tools available [6].

In war-torn Libya, the absence of resources, severity and unpredictability of presenting cases and the lack of specialist health care personnel make a case for care providers to receive specialist training in the management of such injuries in less stable parts of the world [7, 8]. Humanitarian emergency aid organisations in conflict zones are limited by a shortage of both healthcare providers and medical supplies [9]. Since 2011, the health service in Libya has deteriorated despite the end of the war [10]. A survey of 607 surgeons in 13 hospitals within Tripoli, Libya between June 2014 and May 2015 suggested that surgeons practising in Tripoli hospitals are unable to deal with blast injuries with 496 (81.7%) surgeons stating that hospitals in Tripoli were not adequately equipped [11]. CMF injuries represented in the literature range from 20% and 39% of the total

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trauma burden in major military conflicts from World War II to Operation Iraqi Freedom [12, 13].

The head and neck region includes vital anatomical structures that provide the facial movement for communication. Specialist surgical techniques are required and, in the field, should be efficient with competent surgeons available on the front line [14, 15]. Experts in critical care and CMF soft tissue trauma are also essential in a war environment [16]. This paper presents an analysis of civilian and combatant CMF injury patterns to facilitate the establishment of educational and training interventions for the non-specialist health care professionals who often become the primary and definitive care providers for patients with CMF injuries in austere and war zones.

Methods

Case Studies

A case series of 154 patients with CMF war injuries was explored from clinical activity in Misrata between February and November 2011 during the Libyan civil war. The cases were treated within an austere environment and data was retrieved and analysed retrospectively from any available documentation, particularly photographic. The injuries within the cohort were categorised into 16 CMF anatomical regions: dental injury, alveolar bone, mandibular, maxillary, zygomatic, orbital, nasal, nasal bones, nasoethmoidal, panfacial, frontal, cranial, perioral and salivary gland, periorbital soft tissue and eyelids, cartilage/nose and nerve injury. In addition, other important injury categories such as life and sight threatening injuries were added. Anonymised data was analysed retrospectively, broadly categorised into three groups: upper face, midface including orbit and nose, and lower face including the oral cavity. For each case, as far as was possible, the following were retrieved from available records: admission date, age, gender, non-civilian vs. civilian background, mechanism of injury, presence or absence of a foreign body and operation date.

Results

A total of 154 CMF cases were used in this study with the majority being males (94.8%) aged between 18 and 60 (83.1%) assuming that a large number of these people were directly involved in the conflict while there was some representation of children (Table 1). The major cause of CMF injury of this cohort was from blast (75.3%) which was expected with large scale shelling and bombings. The second most common injury was caused by gunshot (19.5%). Shrapnel was the main foreign body found as a consequence of the high number of blast injuries accounting for 77.8%, with 22.2% of patients had bullets removed from the CMF area.

Misrata life-threatening injuries include the presence of tracheostomy, intubated patients in the intensive care unit (ICU), CMF haemorrhage, and airway hazards such as broken teeth and foreign bodies as well as brain herniation that came to our attention from patient scans were available (Table 2). Furthermore, it was important to address that some minor or mild CMF cases were associated with other major injuries of the rest of their body. In austere environments, even simple CMF wounds could prove to be life threatening if not treated due to the vascularity of this region. It should be noted that 28 of the 154 casualties suffered from fatal injuries. Sight-threatening injuries were categorised based on the presence of orbital injury and affected a slightly higher proportion of the sample with 43.5% of cases. Cases were categorised by the region of injury as upper, middle and lower facial thirds. With regards to injuries to each the individual thirds, there was a similar number of upper and lower third injury and an over-representation of midface injuries.

Table 1: Misrata CMF injury case demographics.

Category	Number	Percentage
Age Group		
< 6 yrs.	8	5.2
6 - 12 yrs.	8	5.2
13 - 18 yrs.	8	5.2
19 - 60 yrs.	128	83.1
> 60 yrs.	2	1.3
Total	154	100
Gender		
Male	146	94.8
Female	8	5.2
Total	154	100
Mechanism Of Injury		
Blast	116	75.3
Gunshot	30	19.5
RTA	6	3.9
Trauma	2	1.3
Total	154	100
Foreign Body		
Shrapnel	84	77.8
Bullet	24	22.2
Total	108	100

Table 2: Summary of CMF injuries by injury pattern and facial zones.

Category	Number	Percentage
Injury Pattern (154)		
Life-threatening injury	51	33.1
Sight-threatening injury	67	43.5
Soft tissue injury	113	73.4
Nerve injury	103	66.9
Injury By Facial Thirds (154)		
Upper Third	87	56.5
Middle Third	104	67.5
Lower Third	80	51.9
One Third Affected	73	47.4
Two Thirds Affected	66	42.9
Three Thirds Affected	15	9.7

As expected, soft-tissue injuries affect the majority of the cases accounting for 73.4% of cases. Moreover, 103 cases were affected by soft-tissue injuries and supplementary nerve injury at 66.9% (Table 3). The most common form of injury was periorbital, accounting for 55.2% of cases. All other sites of injury were similarly distributed for the cases which corroborates the findings that injuries were distributed to all facial thirds which in turn is likely to be the result of the large number of blast injuries. Due to the nature of injuries in Misrata, it is evident that the entire face is affected. Nonetheless, the proportion of mandibular and orbital injuries highlights that despite a wide spectrum in severity, there

are strong implications that a patient could suffer in the long term. This may be visual impairment or mandible injuries that could affect a person's feeding, without considering the social and psychological issues associated with facial deformity.

Table 3: Soft tissue categories of CMF injury patients.

Category	Number	Percentage
Site Of Injury (154)		
Dental & Alveolar Injury	36	23.4
Nasal Injury	40	26.0
Mandibular Injury	33	21.4
Maxillary Injury	43	27.9
Zygomatic Injury	25	16.2
Orbit Injury	52	33.8
Cranial Injury	42	27.3
Perioral & Salivary Injury	60	39.0
Periorbital & Eyelid Injury	85	55.2

Discussion

The data collected from the 154 patients provides an insight into the pattern of CMF injuries during civil conflicts. Firstly, the majority of patients were aged between 18 and 60, which was not surprising as they were likely physically involved in the conflict and thus, more likely to be injured [17]. It should also be noted that the majority of cases were male, as it is more common for men to participate in war and have trauma involving the CMF area [18]. This data corresponds with previous research concerning the mechanism of injury where most injuries were caused by blasts [7, 19]. Gunshot injuries ranked second for causation surpassing RTAs which would be the primary cause of CMF injury in non-war environments [20, 21]. This not only shows the need for recognition of new types of injuries including other patterns affecting the facial region, but also vividly paints the traumatic changes brought by the conflict [19].

It is acknowledged that the severity of the injuries has also progressed over time. The advancement in war weapons means less use of traditional armament and the introduction of new weapons such as explosive bullets, altering the nature of injuries [22]. CMF injuries are now caused by high velocity blasts leading to severe destruction of both soft and hard CMF tissue. This also increases the presence of foreign bodies in the wound, augmenting the catastrophic character of the laceration but also resulting in the development of further complications, including infection and soft tissue injury [23]. This is further evidenced by the elevated number of both life-threatening and sight-threatening injuries.

To our knowledge, numerous cases were exposed to bullet or blast trauma during the war. Although this may have increased the incidence of injuries, the prevalence remained low as many injuries resulted in immediate fatality of the patient. As a result, a great number of cases were excluded, with many others never been presented to the hospital [4]. The analysed data shows that the sample cases commonly included the involvement of more than one facial third with the middle third being affected the most. This could be due to the lack of protection and the increased exposure of the facial area or the bone quality of this region. It is understood that the results suggest major trauma involving the regions studied, which demands increased awareness, attention and care. This has been addressed by the British military by wearing protecting devices to the important regions in the face [24].

The data of these cases were acquired by the examination of photos taken of each patient. Moreover, it should be noted that due to the lack of good documentation and radiological resources, the reporting of findings may lack precision and accuracy. In addition to this, the inability to apply any of the standardised classification systems such as ZS system available on smartphones, limited our analysis [25, 26]. Documentation and the extraction of findings from pictures alone lacks accuracy and a complete history should be acquired post-triage to appropriately record data regarding the mechanism of injury, exact age as well as specify previous conditions which may explain the severity of injury complications. The absence of prior training focusing on war related cases also affected the documentation analysis as many of the surgeons involved lacked experience of an austere and chaotic environment [4]. Military-trained surgeons are known to be able to document but also analyse such data easily as they have been previously exposed to similar scenarios [27]. Furthermore, scheduling follow-up appointments and a review of patient data would have potentially optimised analysis and potentially provided a better outcome for the patients.

Conclusion

This study provides a valuable guide for the development of future public strategies concerning treatment of CMF injuries in an austere environment. The significance of the understanding of injury patterns and the knowledge of their background have been underlined. There is an educational niche that must be filled in order to successfully recognise the severity of CMF war trauma and triage accordingly. This is especially important in the current climate where terrorist attacks are becoming more frequent and affects more people in areas that did not previously ever suffer from war-like blast and bullet CMF injuries, such as Manchester attacks [19, 28]. In this study we look at the physical impact of CMF injury but have not yet addressed the psychological gravity of such trauma which is of equal importance to surgical treatment. However, the study highlights a number of factors to consider when treating patients with CMF injuries [29].

Author Contributions

Acquisition of data: Abdulhakim W Zaggut, Simon Holmes, Habib Ellamushi, Mohamed Shibu. Data analysis: Gehad Youssef, Muhammad M Rahman. Manuscript writing and review: Abdulhakim W Zaggut, Muhammad M Rahman, Malcolm Harris. Study supervision: Malcom Harris, Ali Ghanem, Simon Myers.

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Conflicts of Interest

None.

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